STATE OF ILLINOIS
DEPARTMENT OF REGISTRATION AND EDUCATION
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DIVISION OF THE
STATE GEOLOGICAL SURVEY
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THE OOLITE OF THE STE. GENEVIEVE FORMATION

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THE OOLITE OF THE STE. GENEVIEVE FORMATION[1]

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The term oolite is derived from Greek words meaning egg and rock, and was suggested by the resemblance of a mass of oolite grains to the roe or eggs of fish. The word oolite is used to describe a rock made up of oolite grains to which the term spherules or spherites is applied. A spherule is defined as a concretion, commonly of calcium carbonate, with an internal radiating and concentric structure. The central nucleus of a spherule may be a foreign particle or may be of the same material as the oolite grain itself.

ORIGIN OF OOLITE

Two different modes of origin have been assigned to calcareous oolite, namely organic and inorganic. In the former case the oolite grains are thought to have resulted from the precipitation of calcium carbonate directly or indirectly by bacteria or algae. The bacteria or algae may have formed the center of the grain or have attached themselves to a foreign body which became the center around which the organisms caused a precipitation of calcium carbonate.

It has been stated that calcareous oolite of inorganic origin has been formed by the precipitation of calcium carbonate around minute particles of sand or other foreign bodies kept in motion so that all sides might become about equally encrusted. The spherical shape of the grains is supposed to have been due to rolling of the spherules on the sea bottom. Somewhat in contrast to this idea Bucher[2] is of the opinion that most oolitic grains were formed from a dispersion medium "by at least one constituent substance changing from the emulsoid state to that of a solid" and that "the spherical shape of the grains is due to the tendency of the droplets forming during this process of separation to coalesce." Further he ascribes the difference between the radial and concentric structure as depending "on

[1]Published by courtesy of the Chief, Illinois State Geological Survey.
[2]Bucher, W. H., On oolites and spherulites, Jour. Geol. V. 26, 1918, p. 602.

the amount of other substance thrown out simultaneously with and mechanically enmeshed in the growing structure.''

In either of the cases mentioned in the above paragraph it would seem possible that organic remains might be trapped within oolite grains during their formation without actually playing a primary part in their development or growth.

THE STE. GENEVIEVE OOLITE

The Ste. Genevieve is the uppermost formation of the lower Mississippian system. It is exposed in the southern and western parts of Illinois and is, in general, a very pure limestone. The lithologic character of the formation varies both horizontally and vertically, but the presence of conspicuous beds of oolite is one feature which is widespread and constant. Locally this oolite is cross-bedded. The spherules vary from a fraction of a millimeter to a maximum of about 2 millimeters in diameter, and are composed dominantly of calcium carbonate. Included with the calcium carbonate are small amounts of disseminated organic and argillaceous material. None of the sections of Ste. Genevieve oolite examined suggested an organic origin of the spherules and they are therefore thought to have been formed by inorganic means.

TYPES OF SPHERULES FOUND IN THE STE. GENEVIEVE FORMATION

The Ste. Genevieve oolite contains spherules in many different stages of development, and it is difficult to divide the forms into groups which will have a sharp line of demarcation. It is possible, however, to recognize three distinctly different types of spherules as follows: (1) those with an angular central grain, (2) those with a rounded central grain, and (3) those which show no distinct central grain.

The first type of spherule with an angular central grain is illustrated by the spherule near the center of Fig. 1 and by Fig. 2. In some spherules the central grains are surrounded by but one ring of calcium carbonate, but in

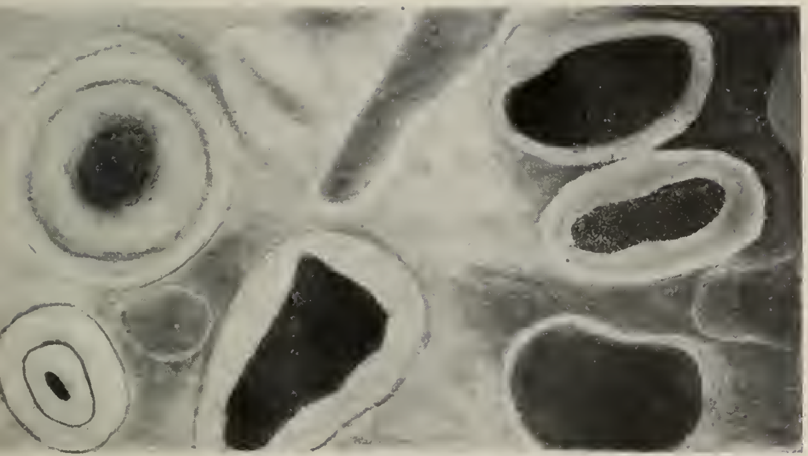

Fig. 1. Drawing of etched polished surface of oolite. Magnified about 50 times.

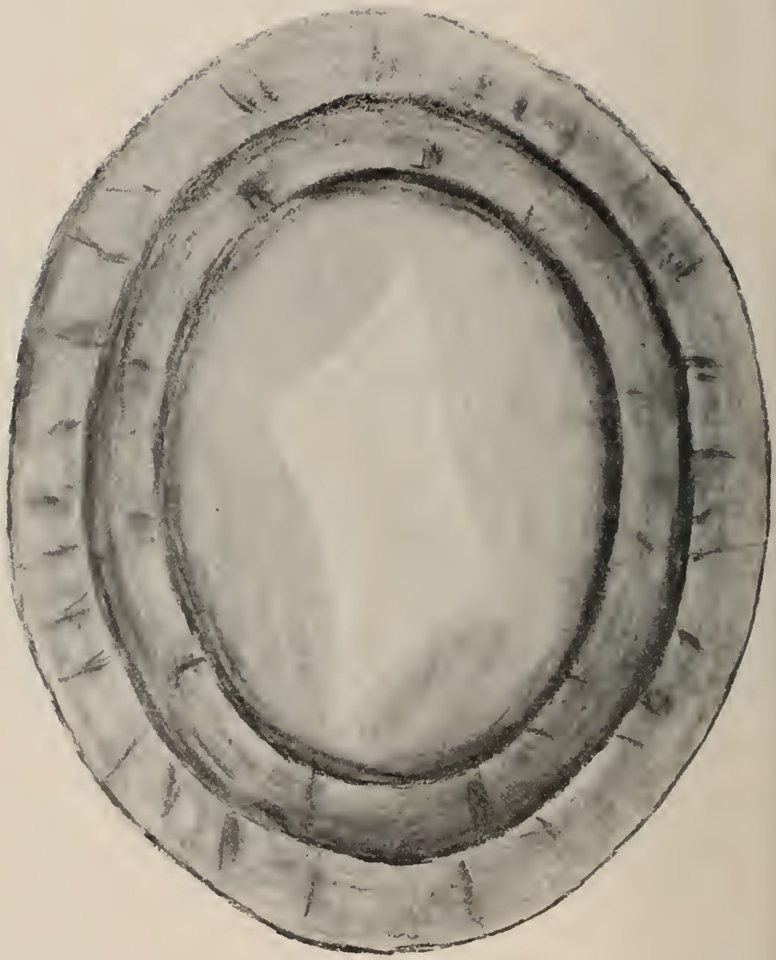

Fig. 2. Drawing of thin section of spherule of type 1. Magnified about 125 times.

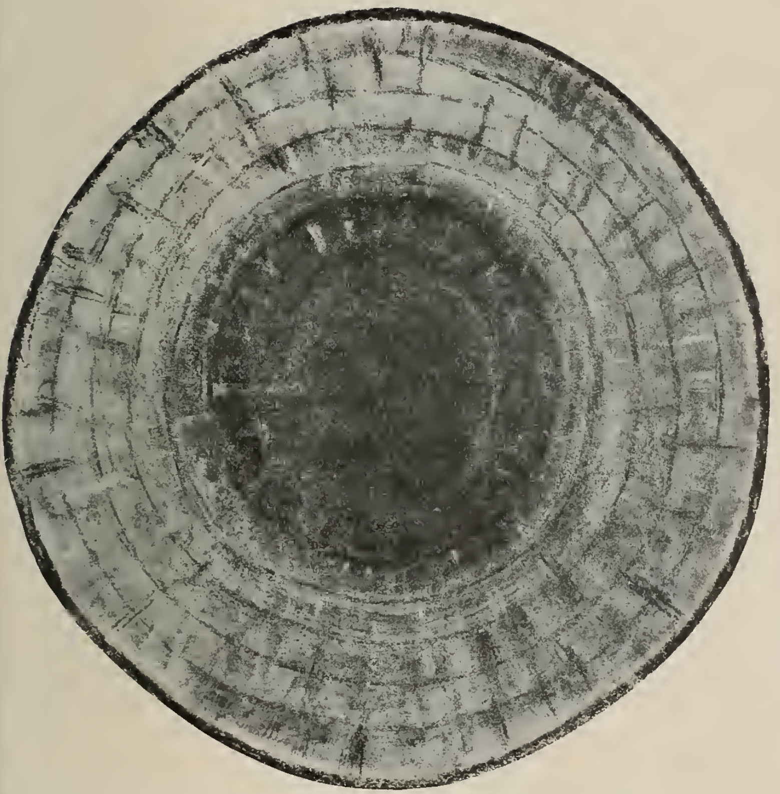

Fig. 3. Drawing of thin section of spherule of type 3. Magnified about 125 times

Fig. 4. Drawing of thin section of spherule of type 3. Magnified about 120 times.

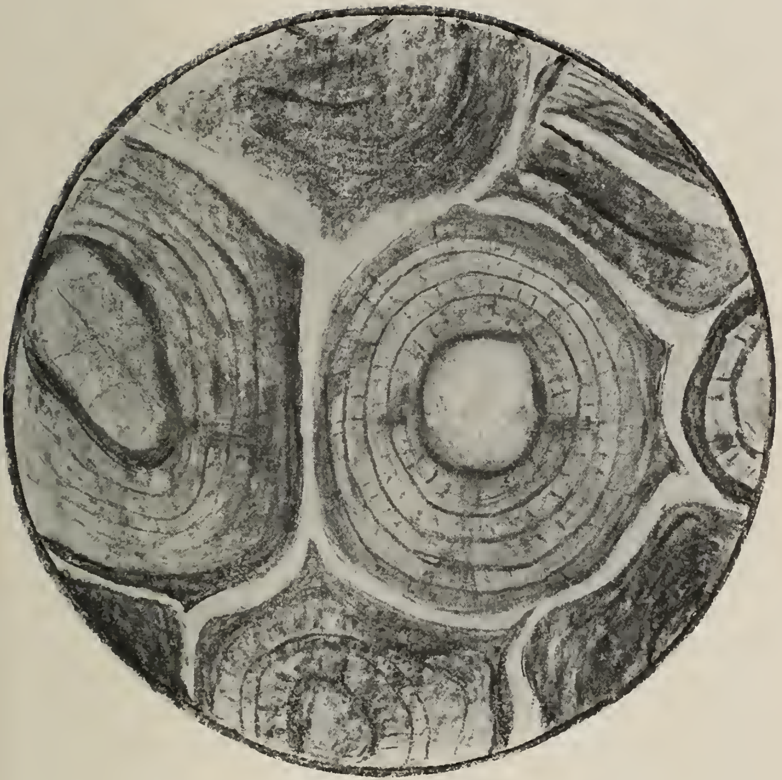

Fig. 5. Drawing of thin section of oolite. Magnified about 50 times.

many four or five concentric deposits are present. As many as eight rings have been observed. A radiating structure is commonly present in the material composing the rings.

The second type of spherule with a rounded center is illustrated by four of the forms shown in Fig. 1. In many the centers are almost spherical but more commonly they are ovoid and somewhat elongated. A maximum of nine concentric deposits of calcium carbonate have been noted around rounded central grains and in general a radiating structure is exhibited by the material composing the rings.

The third type of spherule, characterized by the lack of a distinct central grain, is shown in Figs. 3 and 4. Figure 3 shows a form with the concentric and radiating structure well developed and Fig. 4 a spherule in which there is but a slight suggestion of these structures. There are all gradations between these two sorts of spherules. Eleven distinct rings were noted in a spherule of this type and in general they are the more annular of the types described.

THE CENTRAL GRAINS

There are two classes of central grains which may be recognized. The first is illustrated in Fig. 5, and is thought to have been formed by the recrystallization of the calcium carbonate forming the amorphous centers of spherules of the third type such as is shown in Fig. 3. During the recrystallization, the argillaceous or organic material included in the original center was excluded from the growing crystalline center and formed the conspicuous dark ring around the central grain as shown in Fig. 5. These grains were slightly more rapidly soluble in hydrochloric acid than the concentric deposits about them. In the case of the central grain of Fig. 2, it may have been formed in the same manner as the preceding, but the absence of the dark band around the center suggests that either the primary amorphous center was very pure or else the spherule has resulted from the accretion of calcium carbonate around an angular calcite grain.

The second class of central grains is shown in Fig. 1, which is an enlarged sketch made from a photomicrograph of a piece of oolite with a polished surface which was etched with hydrochloric acid. This etching resulted in a more rapid solution of the material surrounding the central grains than of the grains themselves, thus leaving the centers standing as slight projections above the general level of the smoothed surface. The centers are composed of calcium carbonate and also the rings surrounding them, for the specimen was entirely soluble in acid with but a very slight residue. The Ste. Genevieve formation is in parts made up entirely of more or less rounded detrital particles and fragments of shells and tests, some of which still exhibit recognizable structures, and the second type of centers are thought to be such fragments. In some oolites recognizable shell and bryozoa fragments have been noted as spherule centers. The calcium carbonate forming the concentric deposits around these centers may possibly collect around them in the manner suggested under the first mentioned mode of formation of oolitic grains.

SUGGESTIONS AS TO CONDITIONS OF SEDIMENTATION DURING THE FORMATION OF STE. GENEVIEVE OOLITE

One of the outstanding features which a study of the limestones of the Ste. Genevieve formation brings out is the large amount of detrital calcareous material which is associated with the oolite of the formation or is present in beds in which oolitic grains are essentially missing or uncommon. A great deal of this detritus is doubtless derived from the comminution of calcareous tests. A part of it, however, may have been obtained from limestone adjacent to the site of deposition subject to active erosion with comparatively small amount of transportation. This is suggested by what appear in thin sections to be fragments of limestone. One was noted which contained within it two well formed spherules and a form suggestive of a fragment of a crinoid stem. The association of oolite grains and calcareous detritus, the presence of fragments of limestone, taken together with the cross-bedding found in places in the Ste. Genevieve formation, suggest comparatively shallow water conditions, where erosion and transportation were relatively active. The question is raised as to whether the spherules as found have been formed in situ or whether in the deeper waters somewhat distant from the shore, there may not have been an oolite-forming zone where spherules were constantly forming, to be carried shoreward during storms and rough water, there to be commingled with the calcareous sands of the sea beaches, bars, and shore. The thin section from which Fig. 5 is drawn contains no calcareous debris other than a few gastropod shells which show very little evidence of erosion or abrasion. This absence of debris and the development of projections from the outer concentric bands of the spherules suggest conditions favoring uninterrupted growth of the spherules. This section may, therefore, represent the deposits of primary oolite of the oolite-forming zone.

In contrast with the preceding suggestion that oolite may be formed in off shore zones, it may be pointed out that a beach subject to tidal inundation and subsequent withdrawal might well offer a favorable site for the accumulation of calcium carbonate around sand grains, both calcareous and siliceous. The re-working of such a deposit by contemporaneous or later currents without much abrasion may account for the varied occurrences of the spherules.